Live Steam

VOLUME ONE NUMBER SIX 35¢ PER COPY JUNE 1967

WALT DISNEY STUDIOS

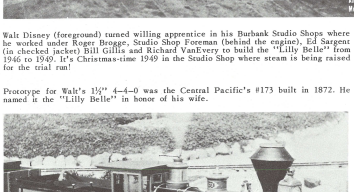
Long Before Disneyland

by OLIVER M. JOHNSTON, JR.
Assistant Manager, Walt Disney Productions
Member, Los Angeles Live Steamers

WALT DISNEY STUDIOS

Walt Disney (foreground) turned willing apprentice in his Burbank Studio Shops where he worked under Roger Brogge, Studio Shop Foreman (behind the engine), Ed Sargent (in checked jacket) Bill Gillis and Richard VanEvery to build the "Lilly Belle" from 1946 to 1949. It's Christmas-time 1949 in the Studio Shop where steam is being raised for the trial run!

Prototype for Walt's 1½" 4–4–0 was the Central Pacific's #173 built in 1872. He named it the "Lilly Belle" in honor of his wife.



Up hill and through dale, over trestles and through tunnels, the Carolwood Pacific Railroad carried its owner, Walt Disney, and its passengers away from the pressures of the day, succeeding fully in its one intended purpose.

When the Santa Fe & Disneyland Railroad began performing that function on a much larger scale, Walt's interest and enthusiasm for Live Steam grew and shifted to that operation and the rails of the Carolwood Pacific were donated to the Los Angeles Live Steamers. Walt took advantage of every opportunity to ride in the cab of the three-foot gauge equipment at Disneyland and the cover photo shows him on one of those occasions.

The LALS Spring Meets were a favorite event for Walt, and he often dropped in at many of the local backyard railroads to indulge in his favorite pastime, Live Steam.

ALL PHOTOS: RICHARD B. JACKSON UNLESS OTHERWISE CREDITED

Dick Jackson's 1" scale 4–4–0 with Walt Disney at the throttle and Ward Kimball, Betty Kimball and Chloe, Ollie Johnston, L. Hiney, Martin Lewis, C. R. Wright and Marie Johnston as passengers. April 4, 1948. (Above)

The "Lilly Belle" and train on the Carolwood Pacific trestle. (Right)

The "Emma Nevada" on Ward Kimball's Grizzly Flats Railroad (three-foot gauge) is the scene of this shot of Engineer Walt Disney on October 20th, 1945. (Lower right)

Bob Day's 2½" gauge Pioneer Mill Railroad was destroyed in the disastrous Bel Aire fire a few years ago, but track ahead was clear on this run on October 12, 1958. (Below)

ART: BRADDOCK

GLLS MAY EXTEND STAY AT GREENFIELD VILLAGE

There is a possibility that the Great Lakes Live Steamers' track installation at Greenfield Village may be kept there for another month. Engineers' Day on June 24th will be following close on the heels of the Old Engine Club meeting on May 11–14 and Live Steam in operation would be of interest to participants in that affair.

At press time the plans are not firm or complete and it will be well to contact George White, 29981 Leona, Garden City, Michigan 48135, phone 313–422-4311 or Eric Corbett, 4128 West Point, Dearborn Heights, Michigan 48125, phone 313–561-3506 before making a special trip to run on their 300 foot loop of 3½" gauge track.

SOUTHERN MINNESOTA LIVE STEAMERS PLAN MEET

A week-end meet of Live Steamers with running facilities for ¾" and 1" scale equipment is planned for August 12th and 13th by the Southern Minnesota Live Steamer Association. Rides will also be available on the 12" gauge trains.

For directions to the Lake City track site or for lodging during the meet, write to Richard M. Winkle at 220 First Avenue Southwest, Rochester, Minnesota 55901.

Scheduled Meets

JUNE

3 GOLDEN GATE LIVE STEAMERS
4 Annual Spring Meet
2½" – 3½" – 4¾" – 7½"
Joseph W. Bryan, Secretary
1225 Scott Street
El Cerrito, California 94530

10 ONTARIO SUNPARLOR LINES
11 Annual Spring Meet
2½" – 3½" – 4¾"
Jack Herr, Secretary
1381 Shepherd Street
Windsor, Ontario, Canada

16 NEW JERSEY LIVE STEAMERS
17 Annual Spring Meet
3½" – 4¾" – 7½"
Ralph Green, Secretary
845 Kilsyth Road
Elizabeth, New Jersey 07208

AUGUST

12 SOUTHERN MINNESOTA LIVE STEAMER ASSOCIATION
13 3½" – 4¾"
Richard M. Winkle, President
220 First Avenue Southwest
Rochester, Minnesota 55901

SEPTEMBER

2 PENNSYLVANIA LIVE STEAMERS
3 Annual Fall Meet
4 2½" – 3½" – 4¾"
Frank H. Moore, Jr., Secretary
211 Walnut Street
Wayne, Pennsylvania 19087

9 GOLDEN GATE LIVE STEAMERS
10 Annual Fall Meet
2½" – 3½" – 4¾" – 7½"
Joseph W. Bryan, Secretary
1225 Scott Street
El Cerrito, California 94530

15 NEW JERSEY LIVE STEAMERS
16 Annual Fall Meet
17 3½" – 4¾" – 7½"
Ralph Green, Secretary
845 Kilsyth Road
Elizabeth, New Jersey 07208

OCTOBER

12 5th ANNIVERSARY RUN
4¾" Gague
James L. Banning
3333 Kahawalu Drive
Honolulu, Hawaii 96817

REGULAR RUN DAYS

GOLDEN GATE LIVE STEAMERS
Every Sunday, Weather permitting
2½" – 3½" – 4¾" – 7½"
Joseph W. Bryan, Secretary
1225 Scott Street
El Cerrito, California 94530

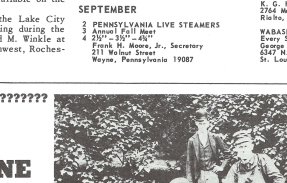
LOS ANGELES LIVE STEAMERS
1st Saturday & Sunday each month
3½" – 4¾" – 7½"
W. Ross Crawford, Secretary
6900 Royer Street
Canoga Park, California 91304

PENNSYLVANIA LIVE STEAMERS
2nd Sunday each month, May thru Oct.
2½" – 3½" – 4¾"
Frank H. Moore, Jr., Secretary
211 Walnut Street
Wayne, Pennsylvania 19087

SOUTHERN CALIFORNIA LIVE STEAM CLUB
3rd Sunday of each month
3½" – 4¾" – 7½"
K. G. Kepner, Secretary
2764 Maple
Rialto, California 92376

WABASH, FRISCO & PACIFIC ASSN.
Every Sunday – 12" gauge
George F. Kiesel, Jr.
6347 N. Rosebury Avenue
St. Louis, Missouri 63105

ANYONE YOU KNOW ?



COLLECTION OF GEORGE F. KIESEL, JR.

Can anyone help identify the persons or equipment in this old photo of a Live Steam 4–4–0? George F. Kiesel, Jr., of 6347 N. Roseburg Avenue, St. Louis, Missouri 63105 sends it along with these comments: "The SHELLPOT is not further identified and no one knows anything about it. It seems to be about 12" gauge and might have been built in 1901 as it was customary to so number the engines. Two comments seem to apply to the loco; the Mother Hubbard cab was unnecessary as it has a narrow firebox, and it has inside-the-frame valves." If you have information, please contact Fred at the above address.

WHEELS, TREAD, AND GAUGE

QUARTERING

The successful operation of any steam locomotive depends upon how well it is quartered; i.e., all right side crankpins are exactly 90° from all left side crankpins. In addition, all crankpin centers shall be equidistant from their axle centers. There are many ways to accomplish this, and each locomotive builder has his favorite method of doing the job. Regardless of what techniques are used, the objective is the same: uniformity of crankpin and keyway location. This is mandatory because the crankpins revolve through their circles and are tied together by parallel rods that are center-to-center, the same as the center-to-center dimension of the driving boxes.

LOCATION OF CRANKPINS (use 4-jaw chuck)

1. Face back of *all drive* wheels and rough turn the flanges 1/16" oversize.
2. Face front and turn tread of one of the drive wheel 1/16" oversize. Prick punch wheel center, using witness mark made when facing hub center. Since the prick punch will not go in the exact center, it will be necessary to indicate the prick punch mark and, if necessary, true the wheel to the prick punch mark.

2a. Obtain a piece of straight 3/16" round stock about 12" long, drill a center in one end with a center drill and turn a sharp 60° center on the other end. Place the drilled end of the rod on the tailstock center and the pointed end of it in the wheel hub prick punch mark. Hold indicator in lathe tool post and bring contact point into contact with the rod. The amount of prick punch eccentricity will be shown on the indicator and can be corrected with the chuck.

3. Paint wheel hub with Dykem layout fluid, and when dry, scribe crank radius using stiff and sharp dividers. Cut scribe line into the wheel hub.
4. Drill, bore, and ream *after laying out and scribing radius*. Remove wheel from chuck and proceed to the next wheel. Check dividers for dimension each time before use.
5. A boring bar with tool bit ground to keyway width may be used to cut the keyway in the lathe by locating the tool bit on the side of the boring bar and then cranking the boring bar through the axle hole by the lathe carriage hand wheel. Care must be taken to get the boring bar and tool bit on the lathe spindle center. Also, the keyway should be in line with the wheel crankpin hole and crankpin hub. It must be noted that this method doesn't produce the best keyway, but where a shaper or a broach is not available, it will do a satisfactory job.
6. Make crankpin centerline fixture from a piece of cold rolled steel. Turn the diameter so that it is a snug running fit in the axle bore. Cut a keyway in the circumference of the fixture, then machine a step in one end. This step (or shoulder) is to align the rule for scribing the axle-crankpin center line and must pass exactly through the center of the fixture and the keyway. The fixture must be aligned in the axle bore with a key that is snug with no play.
7. After scribing the center line, prick punch the intersection of the center line and the crank radius line. This is the crankpin center. Play safe by using a magnifier to assist eyesight. Locate point with a scribe, twist the scribe point into the intersection so that a definite depression *is* made, prick punch lightly. MAKE CERTAIN YOUR TOOLS ARE SHARP!
8. Chuck wheel in the 4-jaw chuck by offsetting it so that the crankpin center will be on the axis of the lathe. Indicate the crankpin prick punch mark. Drill, *bore*, and ream, and repeat on remainder of wheels.

KEY AND KEYWAYS

There are many different types of keys used on machinery, but for the Live Steam locomotive, the simple square key is the proper one to use. The other types will not be discussed here.

Size of square stock key: The key side should be 1/4 the shaft diameter (approximate).

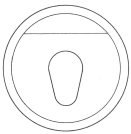
Depth of keyway in shaft: 1/2 the width of the key, measured on side of the cut.

Depth of keyway in hub: 1/2 the width of the key, plus .010" to .020" clearance. The key should be tight on the sides and clear on top.

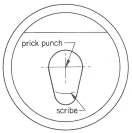
QUARTERING AXLES

Two methods of quartering axles will be given here: the vise method, and the dividing head method. Both methods are good and will produce satisfactory results if care is taken to center the keyway cutter, square the vise or dividing head, see to it that the vise or the dividing head spindle taper and center are clean and free of chips.

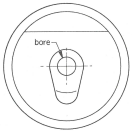
VISE METHOD. A piece of square stock is obtained, any metal is satisfactory so long as it is reasonably larger than the outside of the axle. It shall be bored to a running fit with the axle (0.001" to 0.002" larger than the axle). This hole shall be true with the square stock sides or the keyways will not be 90° apart. Flat point set screws should be used since cup point set screws will create burrs on the axle, making it difficult to withdraw the axle from the fixture. These set screws should be at 90° and should align with the center of the axle. As an alternative, heavy wall square steel tubing may be used so long as the inside of the tubing is true to the axle and is straight and free of mill scale. In any event, when the axle is clamped in position, the set screws must be below the surface of the fixture so as not to interfere with the vise jaws. To maintain uniformity of keyways, it is advisable to use the set screws as check points and mill the keyways in line with them. It should be mentioned at this time that extreme care in centering the cutter and indicating the solid vise jaw is absolutely necessary since the angular displacement of the keyway is multiplied by two when the fixture is turned in the vise to cut the second keyway.



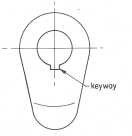
1. Face both sides and turn o.d. of all wheels.



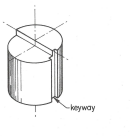
2. Layout axle center and scribe crankpin circle on wheel crank hub.



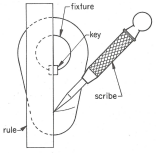
3. Chuck wheel, indicate axle center, drill, bore and ream to size.



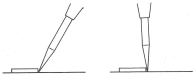
4. Cut keyway.



5. Make crankpin centerline fixture.



6. Scribe centerline, chuck wheel and indicate crankpin center. Drill, bore and ream to size.



SCRIBING PROCEDURE

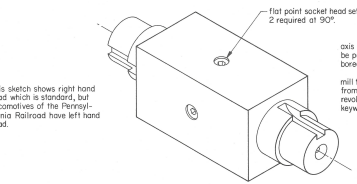
PRICK PUNCH TECHNIQUE

LOCATING CRANKPIN HOLE IN DRIVE WHEELS

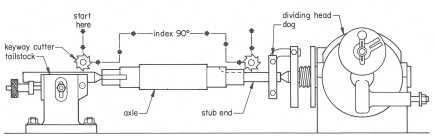
JFN/wd

DIVIDING HEAD METHOD. This method should be used if a dividing head is available since an off-center cutter doesn't change the 90°, it merely results in a drunken keyway. It does, however, require more stock to provide the clamping stub which, after the keyways are cut, is sawed off, faced, and axle recentered with a special boring tool on a steady rest. For the novice: 40 turns of the dividing head handle will revolve the spindle one turn; therefore, 10 turns of the handle will revolve the spindle 1/4 turn, or 90°. Always feed against the rotation of the cutter and not with it. In other words, don't "climb mill."

Turn treads and flanges to their dimensions, contour, gauge, and back-to-back after the wheels have been pressed on their axles. When this is done, make certain that the head stock center runs true. If it does not run true, take a light cut on it to true it up. Most lathes are supplied with one soft center.


flat point socket head setscrews, 2 required at 90°.
axis of hole through block shall be parallel to sides and shall be bored to axle diameter +.002".
mill first keyway, then remove from vise, turn end-for-end and revolve 90°, then cut second keyway.
this sketch shows right hand lead which is standard, but locomotives of the Pennsylvania Railroad have left hand lead.

V I S E M E T H O D



after keyways have been cut, saw off stub end and then indicate end true in lathe; face end, drill small lead hole and then bore 60° center using special-ground lathe tool.

D I V I D I N G H E A D M E T H O D

Q U A R T E R I N G A X L E S

JFN/wcf

WHEEL AND GAUGE STANDARDS

The novice usually doesn't realize the importance of gauge, tread, and flanges when he starts to build his locomotive. This has resulted in embarrassment to all parties concerned when the Club Track Superintendent and the Technical Committee have not permitted his new engine to operate. The engine would be banned from that layout until corrections were made to back-to-back, or gauge and/or flanges. If a person with an out-of-gauge engine gets caught spreading rails, or wrecking frogs and guard rails with insufficient back-to-back, or slicing two-foot aluminum strips from the rails with square flanges, he would be real sorry it happened.

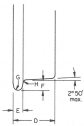
Since gauging rail is subject to variation at its best, it is up to the engine builder to hold his wheels to reasonably close limits. For example, there is 1/16'' difference between the wheel gauge and track gauge on the 1'' scale. Most builders tend to ignore the back-to-back as unimportant. This is not so since a narrow back-to-back will damage frogs, switches, and guard rails. Flanges must have the proper contour so that they will hold the wheels between the rails; yet be shaped so that there will be no undue wear on the rails or the flanges.

FLAT TREAD vs. TAPER TREAD. There is some controversy on this subject. The flat tread boys feel that since the engine pulls the train to the inside of curve, the taper on the wheels is in the wrong direction at this time and extra power is required for operation. This is true of a long drag being pulled slowly around a sharp curve. It has been proven that under these conditions, it takes less power to push the train around the curve since the cars will be pushed to the outside of the curve and the taper on the wheels will be correct. From this writer's observation on Live Steam Models with properly turned and tapered wheels, the wheels will run centered between the rails with the flanges not contacting the rails; not even on curves. This borne out on the writer's rolling stock: after better than ten years of operation, there is some flange polish but no wear.

Due to the variations of the Live Steam roadbed being so great compared to that of the prototype, the accepted standards for Live Steam tread and flanges are slightly different from that listed in the Wheel and Axle Manual compiled under the auspices of the A.A.R. Committee on Wheels. When the dimensions given in these Wheel and Gauge Standards are followed, no problems should exist when operating on any properly gauged layout. No data is given in these Wheel and Gauge Standards for the 1½'' x 7¼'' scale since the author has no source or reliable information; however, the wheel dimensions given here for the 1½'' x 7½'' scale should be satisfactory, even though the gauge and back-to-back is not.

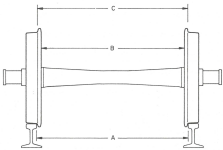
COUPLER HEIGHT is not a critical item due to the adaptability of the standard coupler to height variations; nevertheless, the builder should make an attempt to maintain a uniform coupler height under operating conditions. He should make some sort of a guestimate as to how much a tender and/or passenger-carrying car will sag under load. For a "ball park" figure to start with, set 1'' scale engines 1/16'' high; 1'' cars and tenders 1/8'' to 3/16'' high; and 1½'' scale cars 3/16'' to 1/4'' high.

FREE WHEELS that run free on the axle are produced now and then; however, this requires a good fit on the axle, no lateral on the axle, a means of lubricating the free wheel(s), and careful gauging.



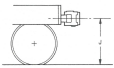
Turn treads and flanges to their final dimensions on centers after they have been pressed on their axles; make certain that the lathe headstock runs true.

TIRE PROFILE



Equipment conforming to these standards will pass inspection of the Southern California Live Steamers and the Los Angeles Live Steamers tracks.

GAUGE AND TREAD



NOTE: Set couplers on passenger-carrying cars approximately ⅛" higher to allow for spring compression.

COUPLER HEIGHT

	SCALE	1½" x 7½"	1"	3/4"
A	Track gauge: tangent	7½" + 1/16 - 0	4¾" + 1/16 - 0	3½" + 1/16 - 0
	curves	7 5/16" + 1/16 - 0	4 13/16" + 1/16 - 0	3 17/32" + 1/16 - 0
B	Back to back of flanges	7⅛" + 1/64 - 0	4 7/16" + 1/64 - 0	3 9/32" + 1/64 - 0
C	Wheel gauge max.	7 7/16" + 0 - 1/64	4 5/16" + 0 - 1/64	3 5/32" + 0 - 1/64
D	Width of tire min.	¾"	9/16"	7/16"
E	Flange thickness max.	.156"	.125"	.094"
F	Flange depth max.	.187"	.156"	.094"
G	Flange radius	*	*	*
H	Gauging radius max.	.094"	.062"	.047"
J	Coupler height (see note)	4 5/16"	2⅞"	2 5/32"

* file to contour

WHEEL AND GAUGE STANDARDS

Part 2

Technical Notes on Tractive Effort

by W. MARSHALL BLACK

Los Angeles Live Steamers

Southern Union #2045—the author's 1" scale 4-6-2 used as a basis for the data in this second part of his series of articles on tractive effort.

Part I of this series showed that limiting starting tractive effort ("t" pounds) is directly proportional to the fraction ("b") of gross engine weight ("W" pounds) on the drivers at any given track condition or adhesion factor ("a"), or: t = abW. (See Equation 3 of Part I.)

In Part II, we will consider (b): how to measure it and what one may rationally do about it. Truckless engine wheel arrangements such as 0-4-0 or 0-6-0 inherently have 100% of weight on drivers (b = 1.0). Hauling performance of models with trucks may be improved with an axle lead tune-up to maximize (b)(t). First, let's consider data taken from some builders' specifications of prototype Pacifics and calculate factors (b) and (a), as shown in Table 1.

The fourth listed engine is a ringer: Southern Union No. 2045 is a somewhat oversized 1 inch scale model, and the weights given are actual pounds, not thousands of pounds. It is interesting to note how well the actual model weight, 240 pounds, fits in the table of prototype weights times 1/1000. This is roughly correct for a 1/10 scale model $(1/10)^3 = 1/1000$. No. 2045 is introduced here because she is going to be examined as a case history momentarily. No. 2045 is fully "equalized" through the drivers. As is common model practice, the equalization is not carried into the trailing truck. Further, the driver springs are not built to pivot perfectly freely on the pedestals.

From Part I it will be recalled that a rigidly coupled(*) two-car train (besides tender) with total of four adults aboard will require about 40 pounds starting effort. Thus, this short train represents about the maximum No. 2045 could handle *without slipping* at the adhesion factor of 0.234 shown in Table 1. On the other hand, No. 2045 has running gear dimensions (1.5 x 2.5 inch cylinders, 5.5 inch drivers) adaquate to develop 101 pounds tractive effort at P - 110 psi and c -0.9; see Equation 4 of Part I. Since this is larger than the weight-limited 30 pounds at a - .234 and b - 0.69 (Table 1), it is clear that more weight could advantageously be shifted onto the drivers, or the engine could be ballasted with lead weights. No 2045 is then, quite typically, an overpowered model for its weight. Prototype practice would never tolerate such a condition. Equation 5 of Part I will be found to check right on the button for any prototype engine although the value of (c) may be closer to 0.85 than 0.90. Let's assume we don't want to add lead weights; rather, we wish to maximize (b) by adjusting the spring rigging to unload the trucks. Here's one way to go about it:

First, fill the boiler to working level, throw some coal in the fire box and weigh the engine on a bath scale to determine (W). Next locate its center of gravity or balance point by placing the engine on a plank laid over a piece of barstock. Make sure the balance point of the plank is over the barstock roller. Then move the engine forward or backward on the plank until it balances see-saw fashion. The free surface effect of water in the boiler will make this difficult, but it can be done. Now measure the distance along rail level from the rear truck axle center to the balance point. On No. 2045 this was 16.9 inches or 0.6 inch forward of the main driver axle. This test is quite diognostic. Right away we know No. 2045 is nose-heavy. A model engine's center of gravity should always be coincident with the midpoint of the

TABLE 1

	Builders' Data, Thousand lbs.			Calculated Values	
	Gross Weight (W)	Wt. on Drivers (bW)	Tractive Effort (t)	"a" (t/bW)	"b" (bW/W)
CSM&O #602 (Alco 1930)	347.0	210.0	51.3	0.244	0.61
PRR #5400 (Baldwin 1915)	310.5	201.6	44.4	0.221	0.65
EXP #50,000 (Alco 1910)	269.0	172.5	40.8	0.237	0.64
SU #2045 (1960)	240.5	164.6	38.6	0.234*	0.69

*Average of values for 3 other engines.

TABLE 2	Trailing Truck		Rear Driver		Main Driver		Lead Driver		Rear Pilot		Front Pilot		Engine Weight (W)
Moment Arm, Inches	0		10.1		16.3		22.6		27.2		34.7		16.9
Observed Wheel Load, Lbs.	15		33		27		25		12		12		240 Lbs.
Observed Axle Lead, Lbs.	30	+	66	+	54	+	50	+	24	+	24	=	248 Lbs.
Adjusted Axle Load, Lbs.	29.0	+	64.0	+	52.2	+	48.4	+	23.2	+	23.2	=	240 Lbs.
Moment, In.-Lbs.	0	+	647	+	851	+	1092	+	632	+	806	=	4028; ok*

* 240 x 16.9 = 4060; this is as close as reasonable

driver wheel base. While you are measuring, also take down the distance from trailing truck axle forward to each succeeding axle (see the first line of Table 2). Next place the engine back on the building bench, *level the bench,* and place a bubble level on a running board. Note carefully the location of the bubble. Use a spring scale to weigh the load on each wheel down one side. Pass a wire loop down behind the running board and around the axle (or crank pin for the drivers with rods up), hook on the scale and pull up until a feeler gage will slip under the tire. Record the wheel loads measured (see second line of Table 2). Double the wheel loads to get the axle loads. Now add the axle loads. The sum should equal (W). (Forces up equal forces down.) This is a first check on the accuracy of the wheel load measurements. The third line of Table 2, shows typical results. On the next line these values are adjusted ("fudged") on a percentage basis so that the sum of the axle loads *will* equal the 240-pound engine weight. Now, as a final check, calculate the moments about the rear truck axle. A moment is a force or load multiplied by its "lever" or "moment arm." The trailing truck load has no lever arm so its moment is zero. Clockwise moments equal counterclockwise moments; therefore, if everything has been measured right, the sum of all wheel loads times their respective moment arms will equal the engine weight times its moment arm as determined by the balancing act. Table 2 illustrates all this for No. 2045 in the "as built" trim that puts 69 per cent of gross weight on drivers.

The method of moments is useful in this sort of test (it was essential on prototypes) because as we make truck loading adjustments, the engine may settle slightly either fore or aft, as indicated by the bubble level. This causes the boiler water to run either fore or aft which drastically changes the engine center of gravity. So much for the method. The procedure for No. 2045 was repeated for two more conditions: with the rear truck completely unloaded, and then with the lead truck completely unloaded. Table 3 shows the results of all these experiments.

Note that Condition B places a desirable fraction of the total engine weight on drivers (about 85%); however, the rear driver is carrying an excessive load as a result. This surely would lead to a broken spring. Curiously, the center of gravity did not shift materially in this condition. Condition C shifted *all* the load onto the drivers; the trailing truck got unloaded unintentionally, because the engine pitched down in front slightly as the free surface boiler water moved forward. The center of gravity (by moment calculation) moved forward 0.7". Obviously, this condition is as objectionable as Condition B. Condition E resulted from lessening the spring compressive force in the pilot truck. It gives the desired driver load without severe differences between driver axles, and it leaves some load on trucks for riding stability. Other adjustments could have been made: shims could have been placed over the lead driver boxes or ballast could have been added to the rear of the engine. In case of completely equalized engines, adjustment of the truck equalizer lever fulcrum points would be in order. What has been illustrated here is that ideally, the model center of gravity should be directly over the mid-point of the driver wheel base.

Footnotes:

(1) *For wide variety of prototype tender engines approximate b = 2/3 (e/0+1/3, where e = number driving axles, and f = total number axles, Exception: Berkshire and Northern; deduct 1/6. Example: (Pacific) b = 2/3 (5/6) + 1/3 = 2/3 = 0.66. Compare with actual values, Table 1.

(2) Spring draft gear permits engine to pick up the train load gradually and thus permits greater self-starting payload. We are assuming here a stretched out train on level track and no "body english" from the engineer.

TABLE 3	Trailing Truck	Rear Driver	Main Driver	Lead Driver	Rear Pilot	Front Pilot
CONDITION A – As Built						
Axle Load, Lbs.	29.0	64.0	52.2	48.4	23.2	23.2
% W	12		69		19	
CONDITION B – Trailing Truck Unloaded						
Axle Load, Lbs.	0	98.0	66.0	40.0	18.0	18.0
% W	0		85		15	
CONDITION C – Lead Truck Unloaded						
Axle Load, Lbs.	0	51.0	89.0	100.0	0	0
% W	0		100		0	
CONDITION E – Final Trim Adjustment Completed						
Axle Load, Lbs.	10	64	64	70	16	16
% W	4		83		11	

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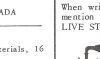

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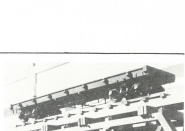

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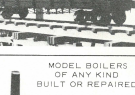

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